Properties of the pseudo-binary wide band gap semiconductor silicon carbide – aluminum nitride

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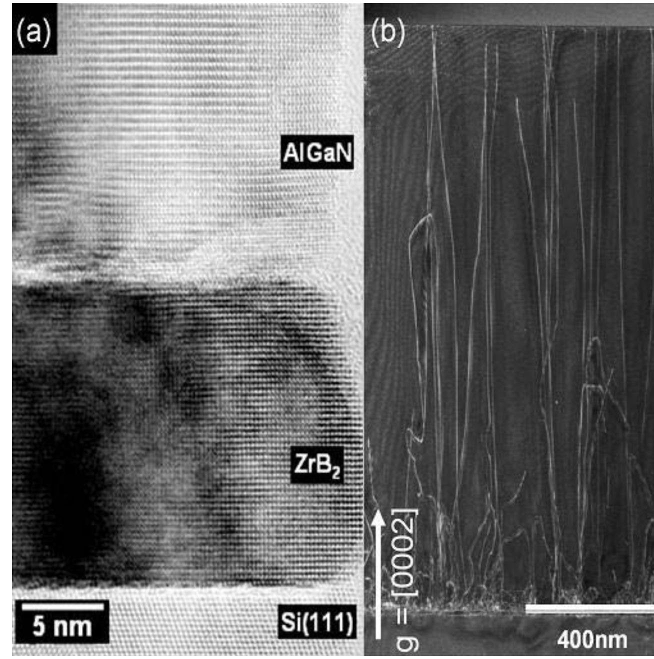
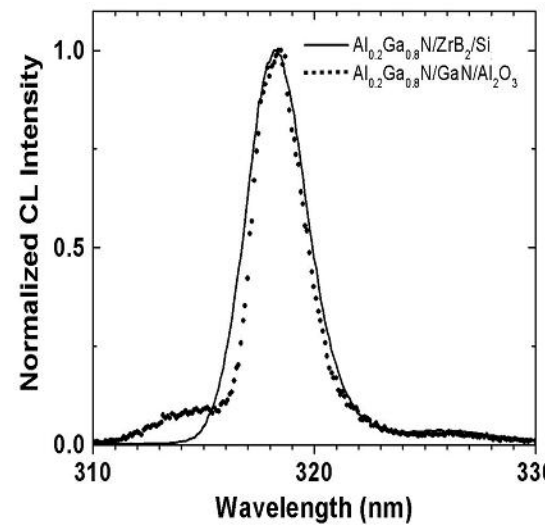
DMR 0303237

One of our research objectives is to grow $Al_{1-x}Ga_xN$ epitaxial layers on Si(111) substrates to demonstrate the possibility of offering low-cost and large-area technologies to group III nitride optoelectronics and microelectronics. To this end, we have successfully grown epitaxial films of $Al_{0.2}Ga_{0.8}N$ by MOCVD at 1050°C on Si(111) substrates via a lattice-matched ZrB_2(0001) buffer layer as shown in the XTEM image (a). The dark-field XTEM image (b) shows the network of threading dislocations in the 1.4 µm thick film. The dislocation density is ~10^{10} cm^{-2} near the film surface. The cathodoluminescence (CL) peak at 318 nm (3.87 eV) with FWHM of 3.3 nm (40 meV) of the film is denoted by the continuous curve in the lower figure. The CL peak of a commercial undoped film of identical composition grown on GaN/sapphire is shown by the dotted curve for comparison. The absolute CL intensity from our film is 3 times higher than that from the commercial film.





J. Tolle et al., Appl. Phys. Lett. **84**, 3510 (2004)

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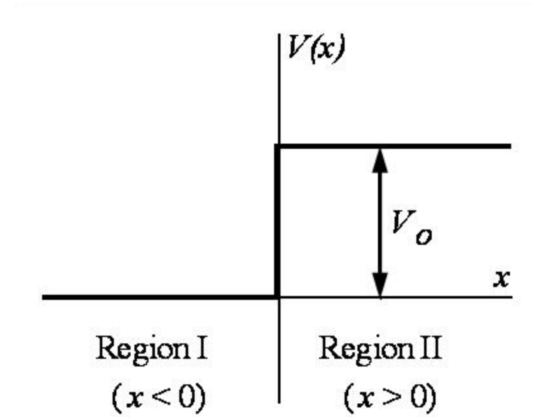
Education & Outreach:
Over the past two decades, physics education researchers have documented conceptual difficulties with introductory physics, primarily Newtonian mechanics, among high school students and university science and engineering majors. Far less is understood of the difficulties encountered by students in more advanced topics such as quantum mechanics. Many students lack a conceptual understanding of waves and are unable to apply basic ideas of probability. In collaboration with physics education professor Luanna Ortiz and graduate student Kevin Gibson, a set of questionnaire has been developed and tested on 90 undergraduates to uncover the students' difficulties. The results will enable us to design activities including visualization tools to help students overcome their misconceptions on probability and wave properties of matter. A typical example of the questionnaire is shown on the right.



An electron beam consisting of a large number of electrons, all with the same kinetic energy *E,* travel from ***left to right*** along *x* through Region I and Region II where the potential energy *V(x)* varies with *x* as shown in the figure. $V(x) = 0$ for $x < 0$ in Region I and $V(x) = V_O$ for $x > 0$ in Region II.

(a) If $E > V_O$, which of the following is the correct statement?
A. All electrons will end up in Region II.
B. Some electrons will end up in Region II.
C. None of the electrons will end up in Region II.
(b) Now consider the case of $E < V_O$. Which of the above is true?